CMOS LOW VOLTAGE, LOW CHARGE INJECTION QUAD SPST ANALOG SWITCHES

GENERAL DESCRIPTION

The ALD4201/ALD4202M are quad SPSTCMOS analog switches specifically developed for 3 to 12 volt applications where low charge injection and low leakage currents are important analog switch operating characteristics. The main features are precision matching, charge compensation circuitry, fast switching, low on-resistance and micropower consumption. The ALD4201 operates in break-before-make switching whereas the ALD4202M operates in make-before-break switching.

The ALD4201/ALD4202M are designed for precision applications such as charge amplifiers, sample and hold amplifiers, data converter switches, and programmable gain amplifiers. These switches are also excellent for general purpose switching applications for micropower battery operated systems.

APPLICATIONS INFORMATION

The ALD4201/ALD4202M are designed to operate with standard single or dual power supplies of +3V to 10V or ±1.5V to ±5V. Functionality extends down to +2V or ±1V power supply, making it suitable for lithium battery or rechargeable battery operated systems where power efficiency and performance are important design parameters. These switches feature nA quiescent current and interface directly to CMOS logic levels from microprocessor or logic interface circuits. Built- in level shifters at the input stage provide for dual supply analog signal switching. On the board level, low charge injection and fast operation can be obtained by using short leads, minimizing input and output capacitances, and by adequate bypass capacitors placed on the board at the supply nodes. For more information, see Application Note AN4200.

The ALD4201/4202M are manufactured with Advanced Linear Devices' enhanced ACMOS silicon gate CMOS process, and are also part of the linear elements in Advanced Linear Devices' "Function-Specific" ASIC.

ORDERING INFORMATION

Operating Temperature Range		
-55°C to +125°C	0°C to +70°C	0°C to +70°C
16-Pin CERDIP Package	16-Pin Plastic Dip Package	16-Pin SOIC Package
ALD4201 DC ALD4202M DC	ALD4201 PC ALD4202M PC	ALD4201 SC ALD4202M SC

LOGIC TABLE

Input Logic	Switch State	
	ALD4201	ALD4202M
0	On	Off
1	Off	On

* Contact factory for industrial temperature range.

FEATURES

- 3V, 5V & 10V supply operation
- ±1.5V, ±2.5V & ±5V supply operation
- 0.1µW power dissipation
- 1pC charge injection
- Rail-to-rail signal range
- Low on-resistance
- pA leakage current
- 4201 break-before-make switching
- 4202M make-before-break switching
- Built-in dual supply level translator

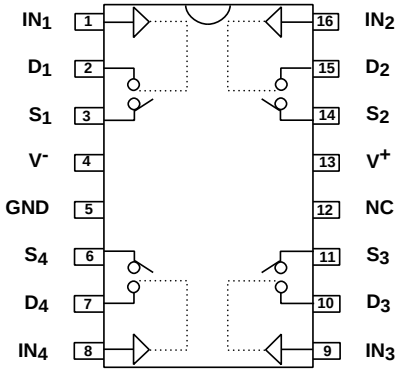
BENEFITS

- Fast effective signal throughput
- Low switching transients
- Low signal loss
- Essentially no DC power consumption
- Full analog signal range over power supply rail
- Flexible power supply range for battery operated systems

APPLICATIONS

- Low level signal conditioning circuits
- Portable battery operated instruments
- Computer peripherals
- PCMCIA
- Fast sample and hold
- Analog signal multiplexer
- Programmable gain amplifiers
- Switched capacitor circuits
- Micropower based systems
- Video/audio switches
- Feedback control systems

PIN CONFIGURATION / BLOCK DIAGRAM



DC, PC, SC PACKAGE

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ABSOLUTE MAXIMUM RATINGS

Supply voltage, V^+ referenced to V^- ——— -0.3V to +13.2V
GND ——— -0.3V to +13.2V
Terminal voltage range (any terminal) Note 1 ——— $(V^-$ -0.3)V to $(V^+$ +0.3)V
Power dissipation ——— 600 mW
Operating temperature range PC, SC package ——— 0°C to +70°C
DC package ——— -55°C to +125°C
Storage temperature range ——— -65°C to +150°C
Lead temperature, 10 seconds ——— +260°C
DC current (any terminal) ——— 10mA

POWER SUPPLY RANGE

Parameter	Symbol	4201/4202M (PC,SC) Min	Typ	Max	4201/4202M (DC) Min	Typ	Max	Unit	
Supply Voltage	V_{SUPPLY}	±1.5		±6.0	±1.5		±6.0	V	Dual Supply
		3.0		12.0	3.0		12.0	V	Single Supply

DC ELECTRICAL CHARACTERISTICS

T_A = 25°C V^+ = +5.0V, V^- = -5.0V GND = 0.0V unless otherwise specified

Parameter	Symbol	4201/4202M (PC,SC) Min	Typ	Max	4201/4202M (DC) Min	Typ	Max	Unit	Test Conditions
Analog Signal Range	V_A	-5.0		5.0	-5.0		5.0	V	
On - Resistance	R_{ON}		90	135		90	135	Ω	V_A = 0V I_A = 1mA
			120	180					0°C to +70°C
						140	210		-55°C to +125°C
Change of On-Resistance from $-V_S$ to $+V_S$	ΔR_{ON}		16			16		%	
Change of On-Resistance with Temperature	$\Delta R_{ON}/\Delta T$		0.43			0.43		%/°C	
R_{ON} Match Between Switches			2			2		%	
Source Off Leakage Current	$I_{S(OFF)}$		50	100		50	100	pA	V_S = +/-4.0V, V_D = -/+4.0V
				500				pA	0°C to +70°C
							4000	pA	-55°C to +125°C
Drain Off Leakage Current	$I_{D(OFF)}$		50	100		50	100	pA	V_D = +/-4.0V, V_S = -/+4.0V
				500				pA	0°C to +70°C
							4000	pA	-55°C to +125°C
Channel On Leakage Current	$I_{D(ON)}$		50	100		50	100	pA	
				500				pA	0°C to +70°C
							4000	pA	-55°C to +125°C
Input High Voltage	V_{IH}	4.0			4.0				Logic "1"
Input Low Voltage	V_{IL}			0.8			0.8	V	Logic "0"
Input High or Input Low Current	I_{IH} I_{IL}			10			10	nA	±1.5 ≤ V_{SUPPLY} ≤ ±5.0V
Supply Current	I_{SUPPLY}		0.01	1		0.01	1	µA	

AC ELECTRICAL CHARACTERISTICS
T_A = 25°C V+ = +5.0V, V- = -5.0V, GND = 0.0V unless otherwise specified

Parameter	Symbol	4201/4202M (PC)			4201/4202M (DC)			4201/4202M (SC)			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max	Min	Typ	Max		
Turn On Delay time	t_{ON}		150 60	240 110		150 60	240 110		150 60	240 110	ns ns	4201 (Note 2) 4202M
Turn Off Delay time	t_{OFF}		60 100	130 180		60 100	130 180		60 100	130 180	ns ns	4201 (Note 2) 4202M
Break-Before-Make Delay Time	t_{BD}	20	90		20	90		20	90		ns	4201 (Note 3)
Make-Before-Break Delay Time	t_{MD}	15	40		15	40		15	40		ns	4202M (Note 3)
Charge Injection	Q_{INJ}		2 1	5 2.5		2 1	5 2.5		1 0.7	2.5 2.0	pC pC	4201 (Note 3) (Note 4) 4202M
Off Isolation			75			75			75		dB	At f = 100KHz, (Note 5)
Crosstalk			90			90			90		dB	At f = 100KHz, (Note 6)
Total Harmonic Distortion	T_{HD}		0.05 0.01			0.05 0.01			0.05 0.01		%	R_L = 10K R_L = 100K
Source/Drain Off Capacitance	$C_{S(OFF)}$ $C_{D(OFF)}$		3.0			3.0			3.0		pF	
Channel On Capacitance	$C_{DS(ON)}$		5.7			5.7			5.7		pF	
Pin to Pin Capacitance	C_{PP}		0.5			0.6			0.25		pF	

DC ELECTRICAL CHARACTERISTICS
T_A = 25°C V+= +5.0V, V- = GND = 0.0V unless otherwise specified

Parameter	Symbol	ALD4201/4202M (PC,SC)			ALD4201/4202M (DC)			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Analog Signal Range	V_A	0.0		+5.0	0.0		+5.0	V	
On - Resistance	R_{ON}		195 240	280 350		195 270	280 390	Ω	V_A = +2.5V I_A = 1mA 0°C to +70°C -55°C to +125°C
Change of On-Resistance from $-V_S$ to $+V_S$	ΔR_{ON}		20			20		%	
Change of On-Resistance with Temperature	$\Delta R_{ON}/\Delta T$		0.43			0.43		%/°C	
R_{ON} Match Between Switches			2			2		%	
Input High Voltage	V_{IH}	4.0			4.0			V	
Input Low Voltage	V_{IL}			0.8			0.8	V	

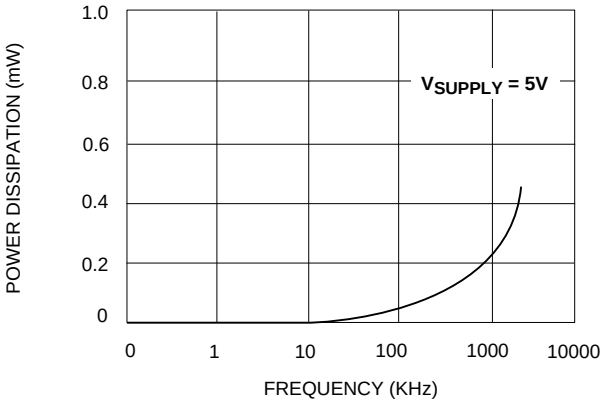
Notes:
1. Voltage on any terminal must be less than (V+) + 0.3V and greater than (V-) - 0.3V, at all times including before power is applied and V+ = V- = 0.0V. Vsupply power supply needs to be sequenced on first on power turn-on and sequenced off last during power turn-off. **2**. See Switching Time Test Circuit. **3.** Guaranteed by design . **4.** See Charge Injection Test Circuit **5.** See Off Isolation Test Circuit **6.** See Crosstalk Test Circuit

DC ELECTRICAL CHARACTERISTICS
T_A = 25°C V^+ = +3.0V, V^- = GND = 0.0V unless otherwise specified

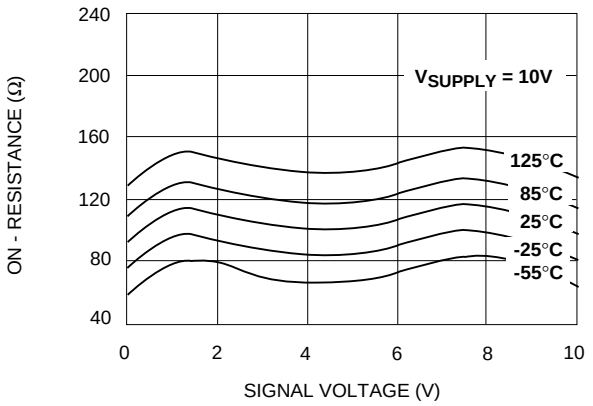
Parameter	Symbol	4201/4202M (PC,SC)			4201/4202M (DC)			Unit	Test Conditions
		Min	Typ	Max	Min	Typ	Max		
Analog Signal Range	V_A	0.0		3.0	0.0		3.0	V	
On - Resistance	R_{ON}		500 620	700 880		500 680	700 1000	Ω	V_A = 1.5V I_A = 1mA 0°C to +70°C -55°C to +125°C
Change of On-Resistance from $-V_S$ to $+V_S$	ΔR_{ON}		43			43		%	
Change of On-Resistance with Temperature	$\Delta R_{ON}/\Delta T$		0.27			0.27		%/°C	
R_{ON} Match Between Switches			2			2		%	
Input High Voltage	V_{IH}	2.4			2.4			V	
Input Low Voltage	V_{IL}			0.8			0.8	V	

TYPICAL PERFORMANCE CHARACTERISTICS

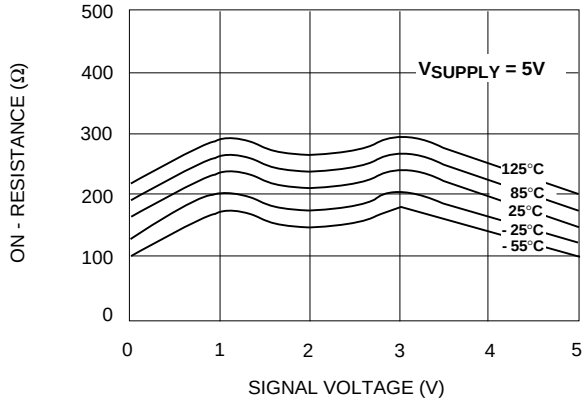
POWER DISSIPATION AS A FUNCTION OF FREQUENCY



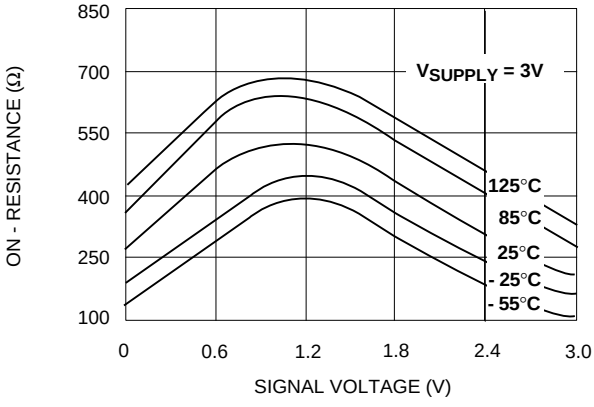
ON RESISTANCE AS A FUNCTION OF SIGNAL VOLTAGE



ON RESISTANCE AS A FUNCTION OF SIGNAL VOLTAGE

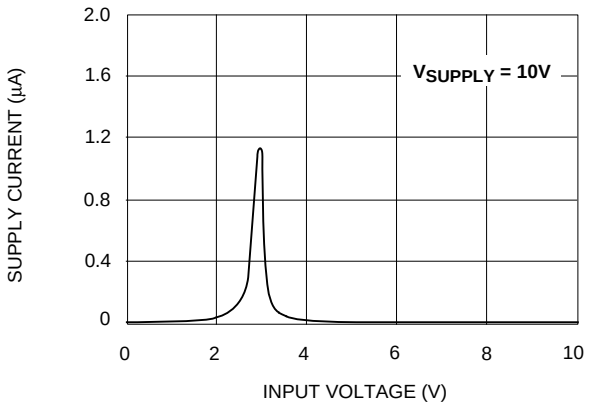


ON RESISTANCE AS A FUNCTION OF SIGNAL VOLTAGE

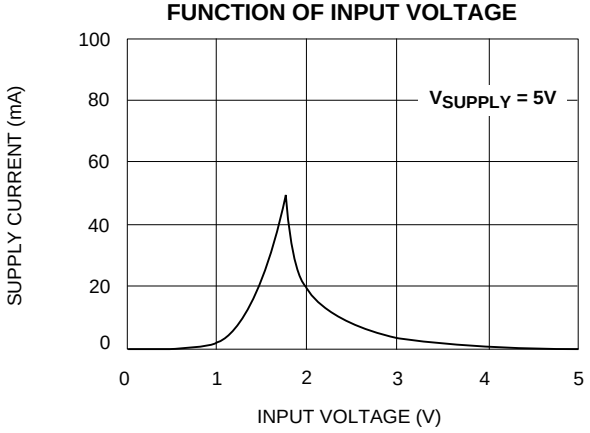


TYPICAL PERFORMANCE CHARACTERISTICS

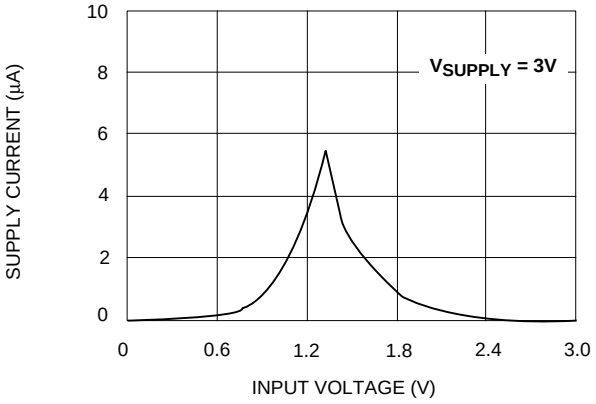
SUPPLY CURRENT AS A FUNCTION OF INPUT VOLTAGE



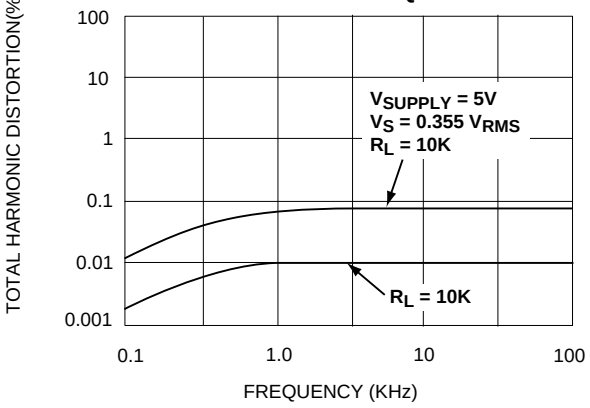
SUPPLY CURRENT AS A FUNCTION OF INPUT VOLTAGE



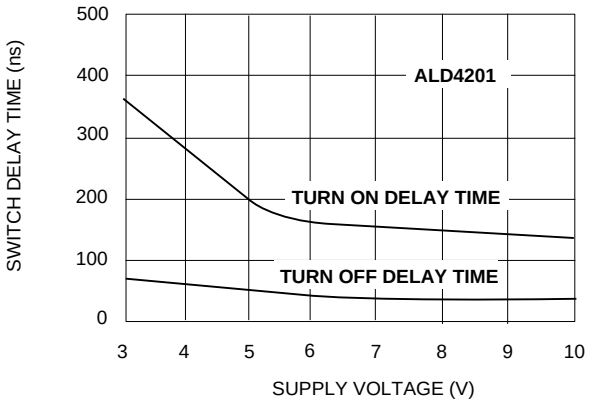
SUPPLY CURRENT AS A FUNCTION OF INPUT VOLTAGE



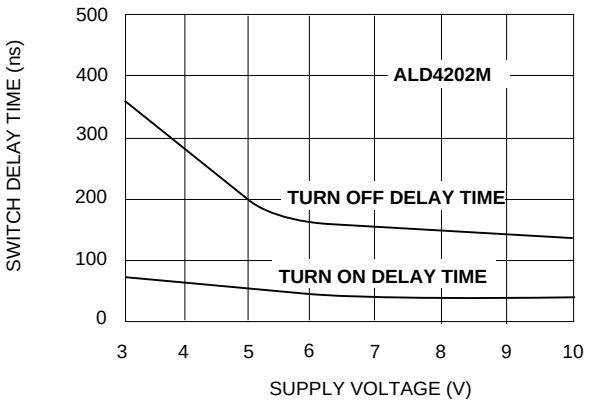
TOTAL HARMONIC DISTORTION AS A FUNCTION OF FREQUENCY



SWITCH DELAY TIME AS A FUNCTION OF SUPPLY VOLTAGE

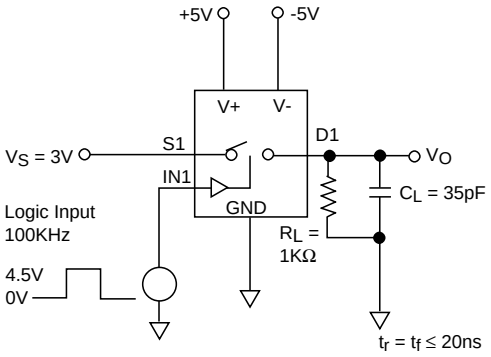


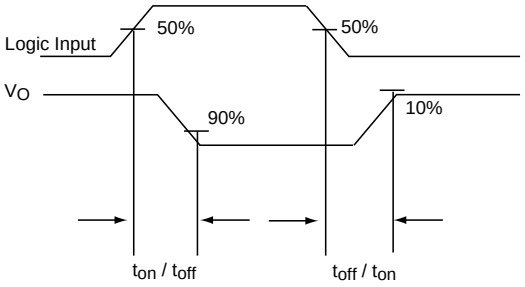
SWITCH DELAY TIME AS A FUNCTION OF SUPPLY VOLTAGE



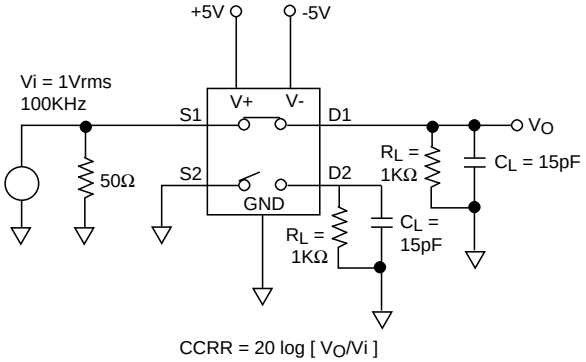
TEST CIRCUITS

SWITCHING TIME TEST CIRCUIT

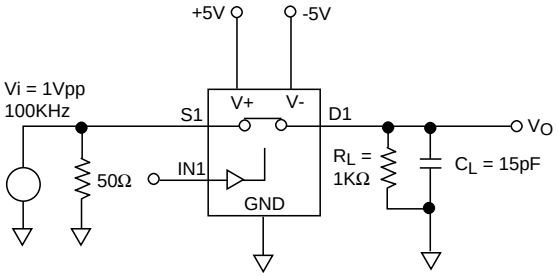




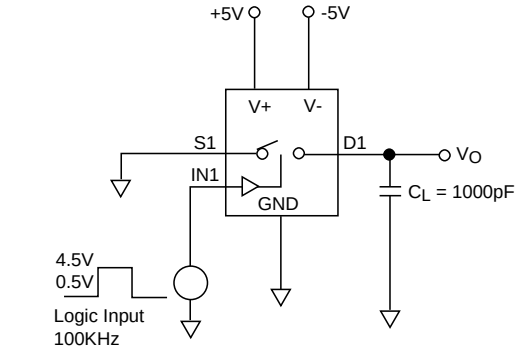
CROSSTALK TEST CIRCUIT

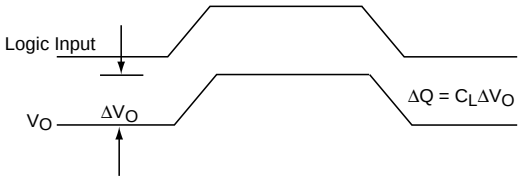


TOTAL HARMONIC DISTORTION TEST CIRCUIT



CHARGE INJECTION TEST CIRCUIT





OFF ISOLATION TEST CIRCUIT